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THE EFFECTIVENESS OF CARBARYL IN REDUCING GYPSY MOTH POPULATIONS AND HOST DAMAGE IN EASTERN PENNSYLVANIA

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ABSTRACT

A single treatment of infested oak-hickory forests in Pennsylvania with a Sevin® -4-Oil formulation of carbaryl reduced gypsy moth populations for one generation. Egg-mass density in the second generation after treatment was similar throughout the infestation because of a widespread population decline. There was foliage protection in the year following treatment, but not beyond, for all gypsy moth food class trees. Tree mortality, especially in the white oak food class, occurred after 3 years in untreated areas. There was radial growth loss from defoliation for all tree species except the red oak food class.

INTRODUCTION

The success of gypsy moth suppression is usually measured by the extent of foliage protection, larval nuisance abatement, and egg-mass reduction. Information on the long-term effects of suppression is important to the development of management strategies.

In the spring of 1971, under a cost-share program with the USDA Forest Service, the Pennsylvania Department of Environmental Resources treated 20,000 acres of oak-hickory forests in the Pocono Mountains of eastern Pennsylvania with a Sevin®-4-Oil[a/] formulation of carbaryl. Carbaryl was aerially applied from Bell 47 helicopters at the rate of 1 pound active ingredient per acre.

During the fall of 1971, the Forest Service initiated a 5-year evaluation of treated and untreated plots in this area to determine the long-term effects of one application of carbaryl in reducing gypsy moth populations.

This report discusses the questions addressed by the evaluation:

1. What were the differences in gypsy moth population levels (egg masses) between treated and untreated areas during 1971-1973?

2. How long did it take populations in untreated and treated areas to reach the same density after treatment?

3. What were the differences in annual defoliation between treated and untreated areas for 1972, 1973?

4. What were the differences in defoliation by food classes?

5. What was the annual difference in tree mortality between treated and untreated areas 3 years after treatment?

6. How much tree mortality occurred in untreated areas after 4 years of defoliation?

7. What was the difference in radial tree growth between treated and untreated areas after 4 years?

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METHODS

Fourteen treatment blocks, each with an equivalent untreated area around it, were designed for the evaluation. A minimum of 10 plots (0.1 acre each) was established for each treated and untreated area of 1,000 acres or less. Larger blocks had one plot per 100 acres. A total of 321 plots were used for data analysis.

The information collected from each plot during 1971 to 1974 included:

a) Current egg-mass numbers
b) Visual estimate of defoliation severity for individual trees and plots
c) Tree species, crown condition, dominance, and diameter at breast height (dbh)
d) Tree mortality

In 1975, increment cores from randomly selected trees in treated and untreated areas were measured to determine radial growth changes from 1971 to 1975.

Food classes I through V were used in the analyses of foliage protection and radial tree growth:

I	II	III	IV	V
White oak	Red oak	Gray birch	Yellow birch	Ash
Chestnut oak	Black oak	White birch	Black birch	Yellow-poplar
	Scarlet oak	Cherry	Black gum	Locust
		Aspen	Hickory	
			Red maple	
			Sugar maple	
			Sassafras	
			White pine	
			Hemlock	
			Beech	
			Juneberry	
			Dogwood	
			Pitch pine	
			Butternut	

Analysis of variance was used for all determinations of significance ($P \leq 0.05$).

RESULTS

Population reduction

Egg masses per acre of treated and untreated areas ranged from 200 to 5,000 in the 1970-1971 generation[b/]. Following treatment in May 1971, the average number of viable egg masses per acre between treated and untreated areas was significantly different in the 1971-1972 generation. By the next generation, however, populations in untreated areas decreased to a density that was not significantly different from the treated areas (Table 1). This was the start of the population decline.

Table 1.--Average number of gypsy moth egg masses per acre in treated and untreated areas between 1971 and 1975 following a single application of carbaryl in May 1971.

Generation	Treated	Untreated
1971-72	106±67	915±311
1972-73	286±151	590±210
1973-74	186±56	238±78
1974-75	0	0

Foliage protection

In 1972, 1 year after treatment, there was no significant difference in defoliation between composites of all treated and all untreated species (7 percent, range 1 to 17 percent on treated plots; 19 percent, range 0 to 51 percent on control plots). In 1973, defoliation was virtually the same in treated and control plots (31 versus 29 percent). In 1974, there was no measurable defoliation in the untreated or treated areas because of a general population collapse.

When the data were analyzed by food class, however, there was a significant difference in tree defoliation in treated and untreated areas for each food class 1 year following treatment (1972) (Table 2). However, there was no significant difference in defoliation for any of the food classes in 1973.

b/ Only a range is available for this period.

Table 2.--Tree defoliation in treated and untreated plots by food class, 1972-1973.

Food class	Plot type	1972	1973
		----------percent----------	
I	Treated	18.7	55.3
	Untreated	48.0	69.5
II	Treated	4.1	34.4
	Untreated	20.6	41.9
III	Treated	6.9	15.3
	Untreated	24.1	16.9
IV	Treated	1.1	18.4
	Untreated	7.8	17.9
V	Treated	0.1	0.3
	Untreated	0.8	0.1

Tree mortality

The cumulative percent of all species of treated trees that died was significantly smaller than that of untreated trees that died (Table 3).

Table 3.--Percent of tree mortality[c/] in treated and untreated plots for all species and for the white oak group, 1972-1974.

Year	Treated			Untreated		
	All species	White oak	Chestnut oak	All species	White oak	Chestnut oak
1972	1	2	2	4	4	16
1973	3	3	5	7	9	23
1974	6	6	10	11	15	30
:Total number of trees in 1974						
	3,370	799	864	3,083	716	799

[c/] Cumulative from 1971.

When the data were analyzed with the percentage of mortality for the white oak group only, the degree of protection through treatment appears more dramatic.

There was a highly significant difference in annual tree mortality between treated and untreated areas for all 3 years for both white and chestnut oak.

Radial tree growth

In 1971, the average rate of growth for trees of each species was the same in treated and untreated areas. Table 4 shows the average annual growth for each of 5 years for trees representing four of the food classes. The rates indicate the slow growth of all trees within the evaluation area.

Table 4.--Average radial growth of representative tree species in treated and untreated areas, by food class, 1971-1975.

Food class and representative tree species	Year					Average Loss 1971-1975
	1971	1972	1973	1974	1975	
	inches					
I-White oak						
Treated	.031	.030	.028	.039	.037	.007
Untreated	.031	.024	.023	.027	.025	
II-Red oak						
Treated	.056	.053	.044	.043	.054	+.001-No Loss
Untreated	.056	.040	.046	.057	.054	
IV-Red maple						
Treated	.037	.031	.044	.033	.039	.006
Untreated	.037	.029	.026	.030	.031	
V-Ash						
Treated	.051	.058	.076	.055	.056	.004
Untreated	.051	.045	.050	.058	.052	

Except for red oak, overall, the trees in treated areas grew significantly faster than in the untreated areas.

DISCUSSION AND CONCLUSIONS

Carbaryl reduced viable egg-mass populations for only one generation decline began throughout the area and was complete by the fourth generation after treatment by carbaryl.

For all food classes, foliage was protected for only 1 year. However, protection was most significant in the white oak group.

Some tree mortality, especially in the white oak group, was prevented up to 3 years after this single treatment. Eleven percent of the original number of trees of all species was lost in untreated areas after 3 years, compared with 6 percent in treated areas. The evaluation area is a marginal commercial forest, and the fact that many of the trees that died were less than 7 inches was duly considered. Also, a relatively high percentage of trees in the white oak group died in the untreated area compared with the treated area. If management considered this degree of loss intolerable, then gypsy moth treatment would be necessary.

Radial growth was better in treated areas than untreated areas for all trees except the red oak group. Reduced growth loss because of treatment actually was very small since the annual radial growth of the entire evaluation area was considered poor. From the results of this evaluation it would be difficult to justify treating gypsy moth in this type of forest solely for the prevention of growth loss.

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Pesticide Precautionary Statement

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